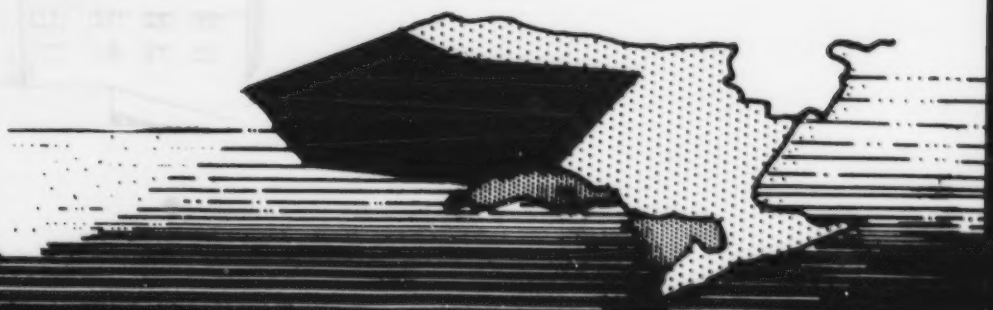

Ministry of Natural Resources
Ontario

NORTHWESTERN ONTARIO FOREST TECHNOLOGY DEVELOPMENT UNIT

# A LITERATURE REVIEW OF SITE PREPARATION AND CONIFER RELEASE TREATMENTS USING 2,4-D, GLYPHOSATE OR HEXAZINONE HERBICIDES

## PART A: TIMING OF APPLICATION

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BY

M.E. Carruthers and W.D. Towill

Northwestern Ontario Forest
Technology Development Unit
Thunder Bay, Ontario.

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## TABLE OF CONTENTS

Acknowledgements

Introduction . . . . . 1

2, 4-D . . . . . 2

Glyphosate (Vision) . . . . . 5

Hexazinone . . . . . 9

References . . . . . 13

## FIGURES

Figure 1: Application timing chart for 2, 4-D (Esteron 600) . . . . . 3

Figure 2: Application timing chart for Vision (Glyphosate) (Monsanto, 1984) . . . . . 6

Figure 3: Application timing chart for Velpar L (Hexazinone) . . . . . 10

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The following individuals have reviewed this document for technical accuracy and content:

Mr. Darko Jovic, R.P.F., Forest Management Supervisor, Geraldton District, Ontario Ministry of Natural Resources, Geraldton

Ms. Cindy Krishka, Vegetation Management Forester, Pest Management Section, Forest Resources Group, Ontario Ministry of Natural Resources, Sault Ste. Marie.

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# A LITERATURE REVIEW OF SITE PREPARATION AND CONIFER RELEASE USING 2,4,-D, GLYPHOSATE OR HEXAZINONE

## PART A:. TIMING OF APPLICATION

M.E. CARRUTHERS [1] AND W.D. TOWILL [2]

## INTRODUCTION

Knowledge of the appropriate time period (the stage of growth or point in season) for herbicide treatments on cutover sites in the boreal forest is important for achieving optimum control of the competing species and minimizing physical damage to the conifer crop trees. Hence, we review suggested application times for 2,4-D, glyphosate (Vision) and hexazinone (Velpar L, Pronone) as documented in the literature. Emphasis has been placed on those results relevant to boreal conditions. Maritime studies and others are discussed separately, since climate and species with potential for competition with conifers are different than in the boreal forest of northern Ontario.

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1 Project Forester, Northwestern Ontario Forest Technology Development Unit, Ontario Ministry of Natural Resources, THUNDER BAY

2 Mixedwood Program Forester, Northwestern Ontario Forest Technology Development Unit, Ontario Ministry of Natural Resources, THUNDER BAY

## 2,4-D

Current standards for the use of 2,4-D in site preparation include the use of the low volatile ester form applied aerially immediately after the hardwoods reach full flush (Expert Committee on Weeds 1984, 1986). The registration label defines 'full flush' as "... when foliage is well developed and actively growing" (Dow, Esteron 600). Site preparation with 2,4-D (low ester) is possible from May until September although maximum herbicidal efficacy will be achieved in the period extending from the beginning of June to the third week in July under normal weather conditions (Figure 1). Herbicidal efficacy is the capacity of a herbicide to cause direct phyto-toxic effects in weeds (Sutton 1984).

In the 1960's, the then Ontario Department of Lands and Forests (now Ministry of Natural Resources) discouraged site preparation using 2,4-D partly due to concern about hardwood resprouting. Indeed, several papers do report sprouting of woody competition one or two seasons after application of 2,4-D (Bunce 1979, Lake States Forestry Herbicide Cooperative 1980). Likely for this reason, it has not often used as a chemical site preparation tool in Northwestern Ontario.

Conifer release treatments employing 2,4-D should be made only after conifers are "hardened off". This is usually indicated by a sharply pointed bud and an absence of lammas growth (Expert Committee on Weeds 1984, 1986) (Figure 1). Maximum efficacy is achieved prior to the onset of fall coloration of the target woody shrub and hardwood vegetation. Even so, only partial control of 'suckering' species may be achieved in subsequent growing seasons (Expert Committee on Weeds 1986). On the moister, more fertile sites or in the absence of drought conditions or cold weather, spraying can proceed until 2 to

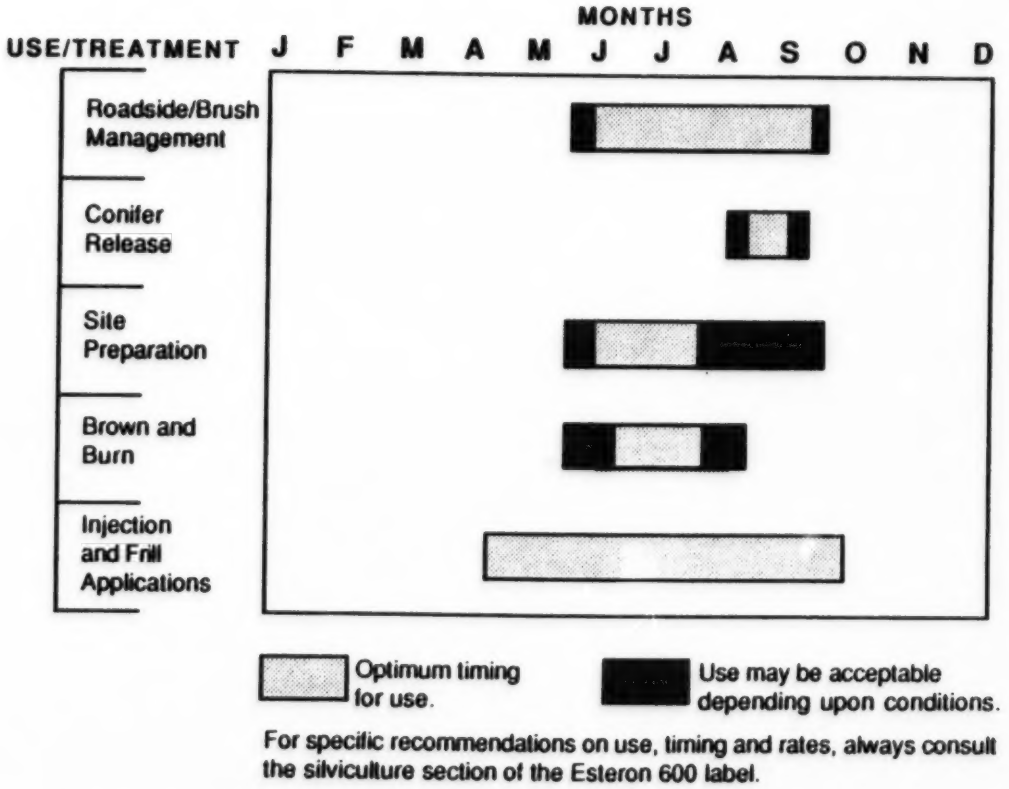

MONTHS
USE/TREATMENT
J F M A M J J A S O N D
Roadside/Brush Management
Conifer Release
Site Preparation
Brown and Burn
Injection and Frill Applications
Optimum timing for use.
Use may be acceptable depending upon conditions.
For specific recommendations on use, timing and rates, always consult the silviculture section of the Esteron 600 label.

**Figure 1:** Application timing chart for 2, 4-D (Esteron 600)

3 weeks prior to frost time (Figure 1) (Dow, Esteron 600). In North Central Ontario this usually coincides with the second week in September. A recent study conducted in Kapuskasing, Ontario, which investigated the relationship between efficacy of 2,4,-D applied to an organic site dominated by Alnus rugosa Du Roi. Koch. found application of the chemical immediately prior to full hardwood leaf expansion to be most effective (Arnup 1986). Unfortunately, this timing also coincided with the period of active flush, growth and shoot elongation for the suppressed black spruce (Picea mariana Mill. B.S.P.).

It is generally agreed that 2,4-D will harm all conifers when it is applied during their period of active growth (Schact and Hansen 1963, Ont. D.L.F. 196_). Black and white spruce (Picea glauca Moench Voss) are relatively resistant to application of 2,4-D after hardening of the current year's growth, but current growth of jack pine (Pinus banksiana Lamb.) is very sensitive and will sustain substantial damage to it often resulting in mortality of the tree in the next growing season. Lammas growth of jack pine occurs commonly in Northwestern Ontario and is also damaged by application of 2,4,-D. Jack pine stands should be released with 2,4-D using low rates (1.1 to 1.6 kg A.I./ha) no sooner than mid-August (Day 1971) and only if lammas growth is absent.

A common concern of managers is controlling trembling aspen (Populus tremuloides Michx.) within jack pine plantations using 2,4-D without damaging the pine. Only one reported example of early release (mid-July) using 2,4-D to control aspen under such stand conditions in North Central Region was documented. This early release resulted in limited mortality of the jack pine in the stand. (J. Ferris, pers. comm.).

Field staff should carefully check the phenological condition of new needle and shoot growth on the conifer to determine potential susceptibility to

herbicide application, particularly, if an early August application is planned. Succulent foliage is a 'red flag' not to spray. On the E.B. Eddy agreement forest, where jack pine release from broadleaved, woody vegetation using 2,4-D is the pre-dominant tending situation, application begins no sooner than the last week of August until September 10 and usually at less than the recommended application rates. This combination minimizes crop risk (K. Ley, pers. comm.).

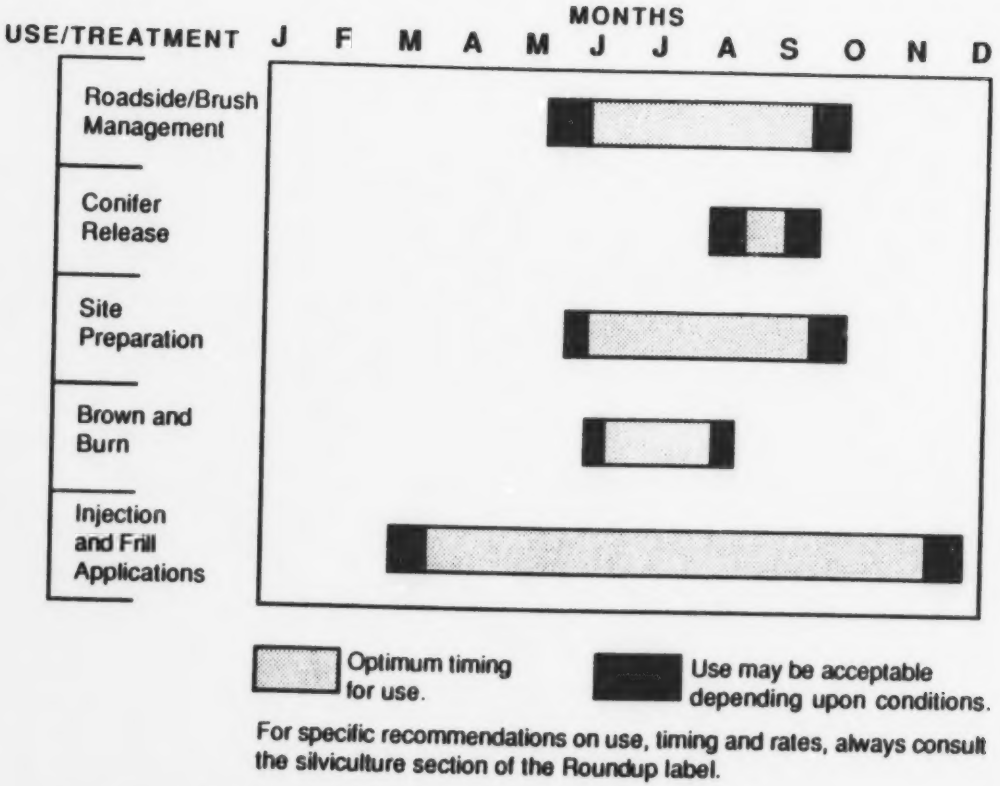
With the advent of other herbicides registered for forestry use, some managers have curtailed the use of 2,4-D for releasing jack pine from unwanted broad leaved and hardwood competition. (G. Campbell, A. Wainwright, pers. comm.).

## GLYPHOSATE (VISION)

Glyphosate (Vision) has been widely tested for herbicide efficacy and species' selectivity in British Columbia and the Maritimes since 1979 (Malik and VandenBorn 1984) and has proven effective as a substitute for 2,4-D / 2,4,5-T in the Maritimes (Dufour and Hallet 1982). An advantage in applying glyphosate is that it possesses long term herbicidal and silvicultural efficacy with maximum control of target vegetation often occurring 2 years after application (VandenBorn 1984).

Chemical site preparation standards provided on the original product label were to apply the herbicide after hardwoods reached full leaf and prior to the onset fall coloration (Expert Committee on Weeds 1984). The Vision label extends this standard slightly to include some coloration of the target species but not major leaf fall (Monsanto 1987) (Figure 2).

Glyphosate application as a conifer release treatment should occur only at the stage of full development of hardwoods if crop damage is to be minimized


MONTHS
USE/TREATMENT
J F M A M J J A S O N D
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Optimum timing for use.
Use may be acceptable depending upon conditions.
For specific recommendations on use, timing and rates, always consult the silviculture section of the Roundup label.

**Figure 2:** Application timing chart for Vision (glyphosphate) (Monsanto, 1984)

(Figure 2) (Gardener 1978; Lake States 1980; Sutton 1984). Application of glyphosate in September generally showed reduced effectiveness on target species (Sutton 1984).

For conifer release, the Expert Committee on Weeds recommends glyphosate treatment only after conifers have developed a sharp bud and in the absence of lammas growth but prior to hardwood leaf coloration (Expert Committee on Weeds 1984). The 1986 standards for control of mixed hardwoods, raspberry, alder and perennial grasses are similar; furthermore, glyphosate does not provide residual control for grasses that have already shed seed prior to the time of herbicide application (Expert Committee on Weeds 1984,1986, Monsanto 1987).

Glyphosate application to a site in the same season as planting of conifers may injure newly planted seedlings (Banden Born 1984). In Ontario this has been observed particularly in the case of current crop container black spruce. In an attempt to prevent potential crop tree damage, a Forest Resources Procedure note prohibits the application of glyphosate in the same season as planting of container stock.

Several studies have confirmed damage to trees planted immediately after glyphosate site preparation (Vanden Born 1984). Vanden Born (ibid.) concluded that a late summer application of glyphosate, using recommended site preparation rates, followed by planting the next spring would provide good control of target vegetation and crop safety. Local experience would suggest that a second release treatment would be required in 2 to 3 years on most Northwestern Ontario sites. A preferable approach is to wait for two years following site disturbance (logging, mechanical site preparation) prior to the first application of glyphosate and follow by planting in the third year. This ensures that most of the early pioneer species are well controlled and little remains of the original on-site seed bank.

Glyphosate damage to conifers following mid-July release applications in the same season as planting have also been documented in the Maritimes (Ingratta 1979). Likewise a compilation of herbicide trial results from Nova Scotia have also confirmed that glyphosate application at release rates between late July and mid-September provided adequate control of woody species and raspberry for the next 3 years (Nova Scotia D.L.F. 1988).

In the Lake States the optimum control period for herbaceous species and grasses occurs in July or earlier (Lake States F.H.C. 1980). Likewise in the Maritimes, control periods were similar but an even earlier treatment resulted in good initial control for one year (N.S.D.L.F. 1988).

Occasional variability in glyphosate efficacy when applied to less vulnerable species has also been documented (Lake States F.H.C. 1980, Boyd et al. 1985). In the Lake States, it has been suggested that drought stress may have reduced glyphosate efficacy, and that physiological condition of the target species could be more critical in determining glyphosate efficacy than that of other herbicides. The present label directs that glyphosate should not be applied during poor growing conditions (Monsanto 1987) which would seem to reflect the findings of these two reports.

Site preparation with glyphosate has greatly increased since its Canadian product registration in 1984. Controlling unwanted aspen sucker growth has been successfully accomplished through chemical site preparation using glyphosate aerially applied in the early summer (K. Ley, pers. comm.). In Northwestern Ontario, ground application of glyphospate using the Bracke herbicider is being tested for a second season by Canadian Pacific Forest Products - Thunder Bay (A. Wainwright, pers. comm.). Many managers have recently adopted using glyphosate for release, particularly in jack pine stands, since crop tree damage is minimal. (G. Campbell, A. Wainwright, A. Matiece, pers comm.)

## HEXAZINONE

Hexazinone differs from 2,4-D and glyphosate because it is principally root absorbed, and has only a minor effect on target or crop species when it contacts the foliage. The label and the Expert Committee on Weeds recommends application of hexazinone in spring before weed emergence or at least prior to full leaf expansion of the target species (Figure 3). The label further recommends that hexazinone should never be applied after full annual growth of the target vegetation has been achieved.

The method of hexazinone application is very important, since it differs depending upon the purpose of application and the target species. Broadcast sprays are commonly used control of grasses, raspberry, and goldenrod for site preparation (DuPont 198_). The only effective and consistent means to control aspen, cherry, alder, birch, and maple for site preparation or release, is spot applications of undiluted or concentrated Velpar L. For release, it is preferable to apply the spots between thaw and conifer flushing time (Figure 3) (Expert Committee on Weeds, 1986). It must be noted that currently hexazinone is registered in Canada for use on fine-textured soils, and via ground application in the form of Velpar L. Pelletized product (eg. Pronone) is often used in reported trials, but this product is not presently approved for operational use.

Planting can occur in the same season as early spring application of hexazinone at low rates. The chemical must reach the root zone of the target species to be effective, therefore the method of application and climate will influence the success of same-season planting. Other soil-related variables

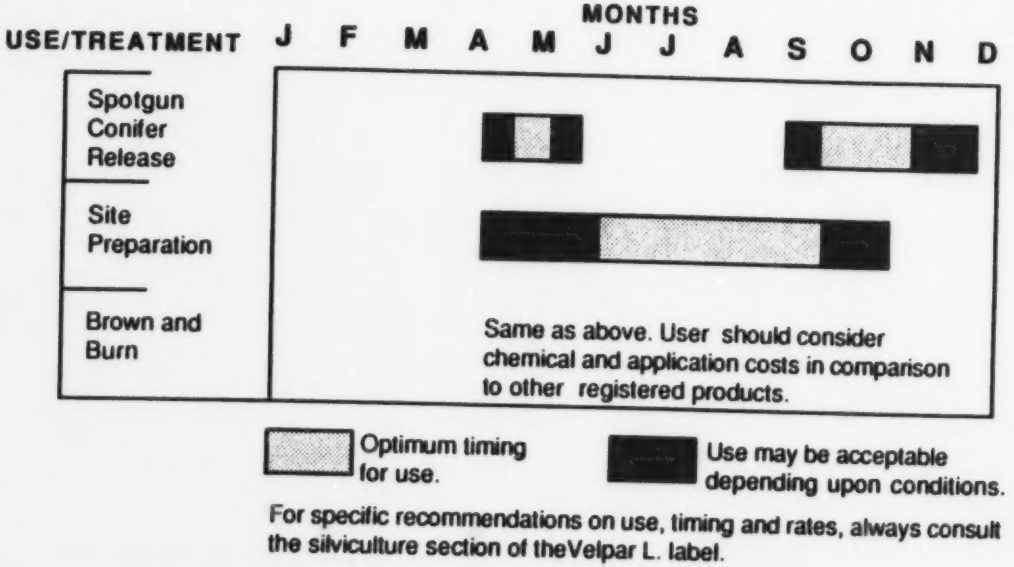
MONTHS
USE/TREATMENT
J F M A M J J A S O N D
Spotgun Conifer Release
Site Preparation
Brown and Burn
Same as above. User should consider chemical and application costs in comparison to other registered products.
Optimum timing for use.
Use may be acceptable depending upon conditions.
For specific recommendations on use, timing and rates, always consult the silviculture section of theVelpar L. label.

**Figure 3:** Application timing chart for Velpar L (Hexazinone)

which will influence the degree of efficacy and crop tree damage are soil texture, organic matter content, and moisture conditions. The influence and importance of these factors on hexazinone efficacy remains poorly understood.

Hexazinone has been documented to cause chlorosis in white spruce when applied as a ground spray (Drowin, unknown dates). In two cases, the white spruce showed a better tolerance and release effect when the hexazinone was applied in the Fall. The chlorotic spruce subsequently recovered to a healthy appearance within two years. Spruce chlorosis following release at the recommended time period has been documented in one other study (Sugg 1982).

When applied as a foliar spray in summer, hexazinone gives good initial kill of aspen; resprouting was common in other hardwoods after one year (Sutton 1984). Fall foliar spray treatments were totally ineffective. Jack pine crop trees included in the summer spray underwent defoliation of current growth following the summer treatment, but flushed normally in the subsequent growing season.

In the Maritimes, a late summer foliar spray trial involving hexazinone resulted in overall poor control of woody competition (Reynolds et al. 1986). In contrast, broadcast spray treatments prior to full leaf expansion of target vegetation for site preparation yielded good control of raspberry and grasses, and in one case even small birch (Pitt et al. 1988a, 1988b, Wellman no date, Reynolds et al. 1986, Reynolds et al. 1988).

In other jurisdictions such as the Inland Northwest U.S.A., application of hexazinone during the frost-free period is acceptable. When applied late in the frost-free period the vegetation control is delayed to the following season (Boyd et al. 1985). A report from Minnesota supports the findings that treatments occurring from late July onward provide delayed response into the next growing season (Alm and Whorton 1988).

Spotgun applications of hexazinone are often used for releasing red pine (Pinus resinosa L.) in the Blind River District of Ontario (G. Campbell, pers. comm.). Red pine is very tolerant of the chemical hexazinone and can be planted immediately following chemical site preparation. These hexazinone applications, when applied in a grid pattern for red pine crop tree release, cause only minimal crop tree damage when applied up to 0.5 metre from the stem.

Jack pine, however, is very sensitive to hexazinone and will be easily killed if exposed to the chemical. Campbell (pers. comm.) believes that the lag time required before jack pine can be successfully planted or seeded on or near the spot gun released site is 15 months. In the Northern Region, OMNR, jack pine planted nine months following hexazinone site preparation displayed stunted growth and browning, but no mortality (K. Ley, pers. comm.).

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Titles
Conifer release with hexazinone liquid - Grande Prairie
Conifer release with hexazinone granules - Slave Lake
Conifer release with hexazinone pellets - Slave Lake
Conifer release with hexazinone granules - Salve Lake
Conifer release with hexazinone pellets - Slave Lake

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